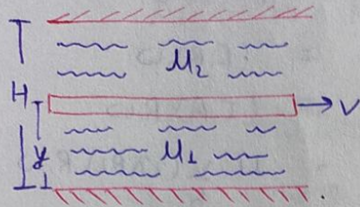
lecture ②

Pb - ③ imp.

Determine y

a) the drag force is equal on both side of the plate

b) the total drag force is mini.



IES 10 mark

H ⇒ very-2 small

ⓐ $F_{D_1} = F_{D_2}$

$\tau_1 A_1 = \tau_2 A_2 \quad (A_1 = A_2 = A)$

$\tau_1 = \tau_2$

$\mu_1 \cdot \frac{V}{y} = \mu_2 \cdot \frac{V}{(H-y)}$

$\mu_1 (H-y) = \mu_2 \cdot y$

$$\boxed{\frac{\mu_1 H}{(\mu_1 + \mu_2)} = y}$$

ⓑ $F_{D_T} = F_{D_1} + F_{D_2}$

$= \tau_1 A + \tau_2 A$

$= \mu_1 \frac{V}{y} \cdot A + \frac{\mu_2 V}{(H-y)}$

$= V \cdot A \left(\frac{\mu_1}{y} + \frac{\mu_2}{(H-y)} \right)$

For mini.

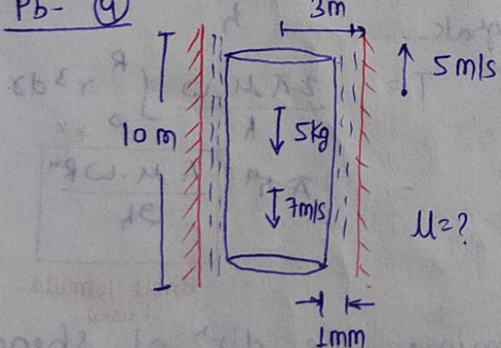
$\frac{dF_{D_T}}{dy} = 0$

$-\frac{\mu_1}{y^2} + \frac{\mu_2}{(H-y)^2} = 0$

$\frac{\sqrt{\mu_2}}{H-y} = \frac{\sqrt{\mu_1}}{y}$

$$\boxed{y = \frac{H \cdot \sqrt{\mu_1}}{\sqrt{\mu_1} + \sqrt{\mu_2}}}$$

Pb- ④



(weight = Resistive force)

Mg = Resistive force

$5 \times 9.81 = \tau \cdot A$

$= \mu \cdot \frac{V}{h} \cdot A \quad (2\pi r L)$

$= \frac{\mu \times (7-(-5)) \cdot (2\pi \cdot (3) \times 10)}{1 \times 10^{-3}}$

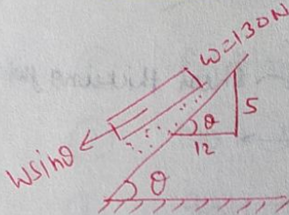
$$\boxed{\mu = 2.16 \times 10^{-5} \ \frac{N.S}{m^2}}$$

$\tau = \mu \cdot \frac{V}{h}$ → V: Relative velocity

exact surface area of cylinder $= 2\pi r h + 2\pi r^2 = 2\pi r (r + h)$

lateral surface area of cylinder $= (2\pi r h)$

Pb-17



$W\sin\theta = \tau_0 . A$

$130 \times \frac{5}{13} = \mu . \frac{V}{L} A = \mu \times \frac{0.5}{0.5\times10^{-2}} \times 1 =$

$\mu = 0.5\ NS/m^2$ Ans

Rheology_

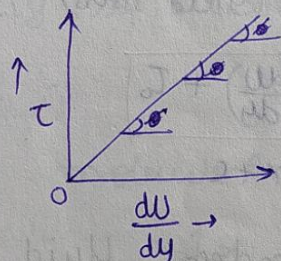
It is branch of science which deals with study of different type of fluid in flow

Newtonian fluid :-

Obey's newton law

$\tau = \mu \frac{du}{dy}$

$Y = m.x$



slope of curve = μ

example → oil, Kerosene, water, mercury, Air, Petrol

Non- Newtonian fluid :-

Don't Obey newtonian fluid

$\tau = A\left(\frac{du}{dy}\right)^n$

A = Consistency index

n = flow behaviour index

Pseudo- plastic (पतले fluid isme ayenge)

$n < 1$

$\tau = A.\left(\frac{du}{dy}\right)^n$

$\tau = \underbrace{A.\left(\frac{du}{dy}\right)^{n-1}}_{\mu_{apparent}} . \frac{du}{dy}$

$\mu_{apparent}$ ↑↓

E.x. Blood
milk

Dialatent (mote fluid isme ayenge)

$n > 1$

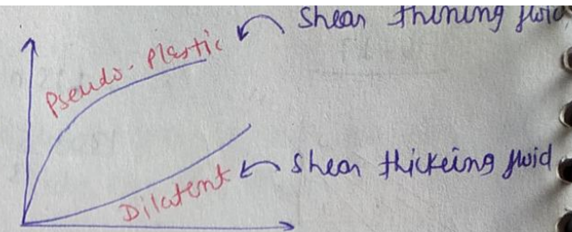
$\tau = A.\left(\frac{du}{dy}\right)^n$

$\tau = \underbrace{A\left(\frac{du}{dy}\right)^{n-1}}_{\mu_{apparent}} . \frac{du}{dy}$

$\mu_{apparent}$ ↓↑

Ex. saturated solution of suger, Rice, starch, soluti
Honey,

Pseudo-Plastic and Dilatent are "time independent fluid"



Bingham Plastic fluid :- [Ideal Plastic] $\frac{du}{dy}$

$$\tau = A\left(\frac{du}{dy}\right)^n + B$$

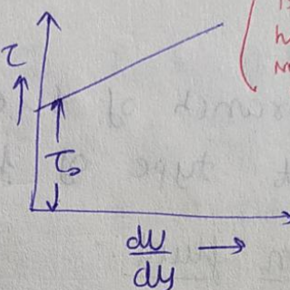
$A = \mu$

$n = 1$

$B = \tau_0$ (yield stress)

$$\boxed{\tau = \mu\left(\frac{du}{dy}\right) + \tau_0}$$

$Y = mx + c$



(iski kuch yield stress hoti hai phir ye Newtonian fluid act krne lgti hai)

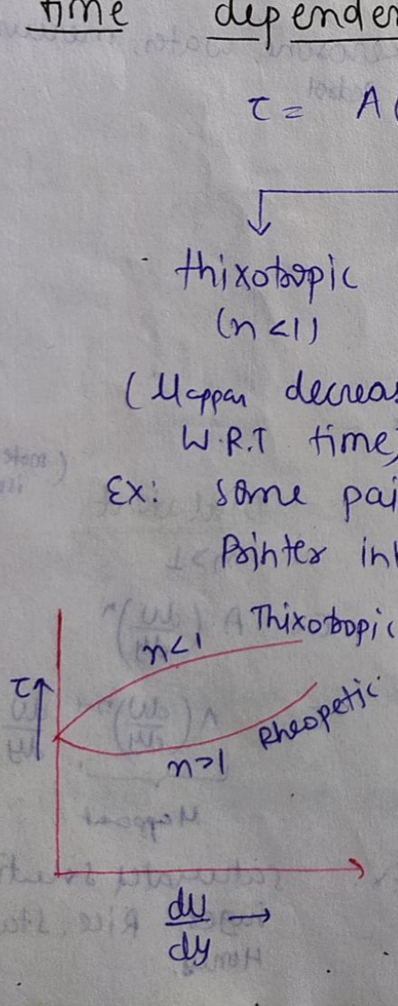
Ex. - Toothpaste
- sewage sludge
- mud clay

time dependent fluid

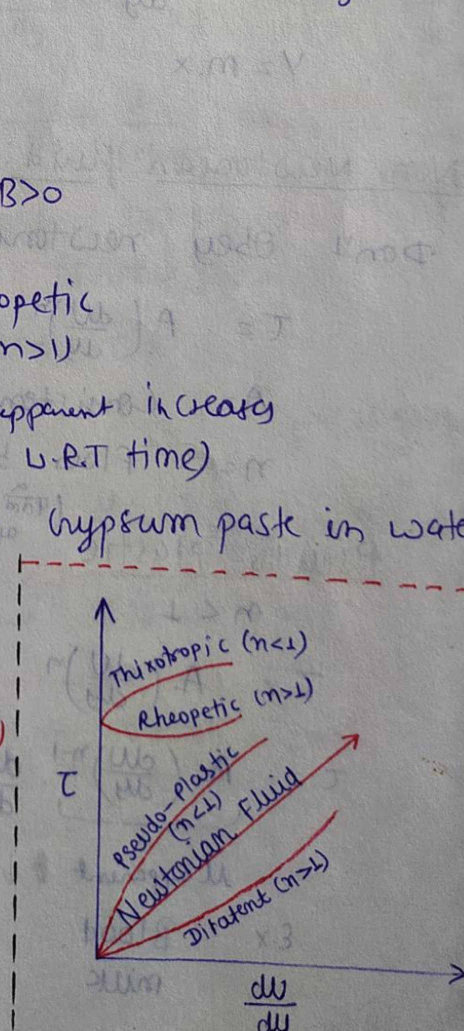
$$\tau = A\left(\frac{du}{dy}\right)^n + B$$

$B > 0$

thixotropic ($n<1$)	Rheopetic ($n>1$)
(μ_{appar} decreases W.R.T time)	($\mu_{apparent}$ increases W.R.T time)
Ex: some paint, Printer inks	Ex: Gypsum paste in water.

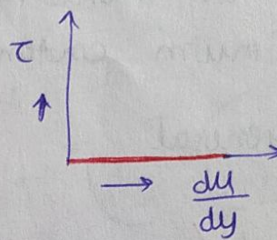


[shear (const)
time



Ideal fluid :-

1. Frictionless and "Inviscid fluid" ($\mu = 0$) ($\tau = 0$)
2. No - surface tension.
3. Incompressible
4. viscosity zero

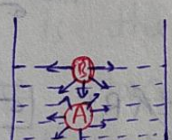


Visco- ellastic fluid :-

these type of fluid having a property of ellasticity upto certain extent

Surface tension effect :-

Experimental view



[$\sigma = 0.073$ N/m for air water interface at temp of 20°C]

molecule A (inside of liquid)

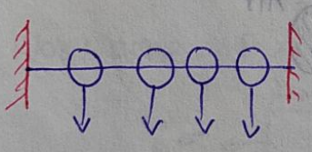
$F_A = 0$

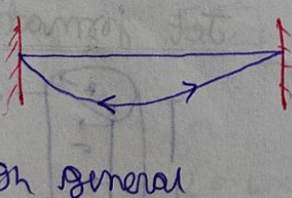
[$\sigma = 0.480$ N/m for air & mercury interface at temp. 20°C]

molecule B (At the surface)

($F_B \downarrow$)

In general



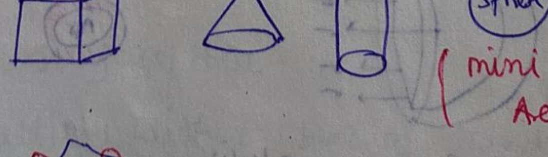


Maths → $\sigma = \frac{F}{L}$ (F = tensile force) (L = length)

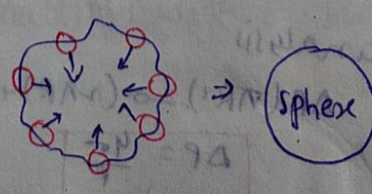
i.e. = (the effect of cohesive force at the surface)

In general

Volume fix

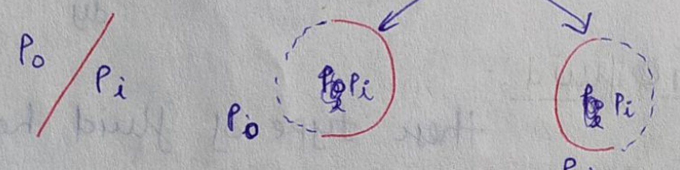


(mini surface Area)



It is the property of liquid by virtue of which tries to minimise the surface area upto the maximum extent.

In general — Droplet formation



$P_i = P_o$ | $P_i > P_o$ | $P_i > P_o$

$$\Delta P = P_i - P_o$$

Water droplet →

Radius = R

[Pressure = $\frac{\text{Force}}{\text{Area}}$ ~~× Area~~]

$\sigma = \frac{F}{l}$

Force analysis

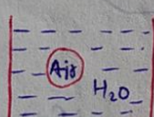
$$\Delta P \cdot (\pi R^2) = \sigma (2\pi R)$$

$\sigma . l = F$

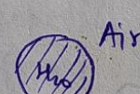
$$\Delta P = \frac{2\sigma}{R}$$

$P = F \times A$

Air bubble in H_2O

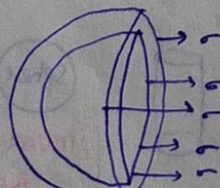


$$\Delta P = \frac{2\sigma}{R}$$

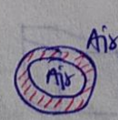


Create special Imp.

② Soap bubble :-



Radius = R

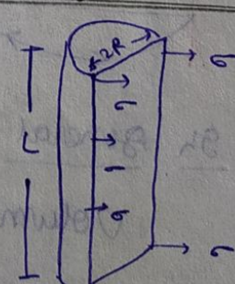


Force analysis

$$\Delta P (\pi R^2) = \sigma (2\pi R) + \sigma (2\pi R)$$

$$\Delta P = \frac{4\sigma}{R}$$

③ Jet formation



Force analysis

$$\Delta P (2 R L) = \sigma L + \sigma L$$

$$\Delta P = \frac{\sigma}{R}$$